

Applicant: Shi-Chang Wooh
For: DEFECT DETECTION SYSTEM AND METHOD

1. A defect detection system comprising:
 - an excitation laser system for projecting a laser beam at the near surface of a sample to be tested for generating acoustic longitudinal, surface Rayleigh, and shear waves in the sample;
 - a detection laser system spaced from said excitation laser to intercept shear waves reflected from the far surface of the sample at approximately the angle of maximum shear wave propagation; and
 - a detection circuit for detecting the energy level of the reflected shear wave intercepted by said detection laser system representative of a flaw in the sample.
2. The defect detection system of claim 1 in which the excitation laser system and detection laser system are on the same side of the sample.
3. The defect detection system of claim 1 including a movable support for said excitation laser system and detection laser system for moving them along the sample.
4. The defect detection system of claim 1 in which said detection circuit includes a shear wave sensing circuit for sensing the energy level of the acoustic wave and the time of arrival of the reflected shear wave at the detection laser system.

1 5. The defect detection system of claim 4 in which said detection circuit
2 includes a first logic circuit for recognizing the presence of a potential flaw if the energy
3 level of the acoustic wave sensed by said shear wave sensing circuit is less than a
4 predetermined level.

1 6. The defect detection system of claim 5 in which said detection circuit
2 includes a surface Rayleigh wave sensing circuit for sensing the energy level of the
3 acoustic wave at the time of arrival of the surface Rayleigh wave at the detection laser
4 system.

1 7. The defect detection system of claim 6 in which said detection circuit
2 includes a second logic circuit for inhibiting recognition of a potential flaw if the energy
3 level of the acoustic wave sensed by said surface Rayleigh wave sensing circuit is less
4 than a predetermined level and confirming recognition if it is greater than the
5 predetermined level.

1 8. The defect detection system of claim 1 in which said detection circuit
2 includes a scanning device for sensing the variation in the energy level of the reflected
3 shear wave along the sample to create shadows of a flaw.

1 9. The defect detection system of claim 8 in which said detection circuit
2 includes a measuring circuit for measuring the length of each shadow cast by a flaw
3 blocking shear wave propagation and the distance between those shadows.

1 10. The defect detection system of claim 9 including a positioning circuit for
2 determining the location, size and orientation of a flaw.

1 11. The defect detection system of claim 1 in which the sample includes steel
2 and the angle of maximum shear wave propagation is approximately 40°.

TOP SECRET

- 1 12. A method of detecting a defect in a sample comprising:
2 photoacoustically exciting acoustic longitudinal, surface Rayleigh, and
3 shear waves at a first point on the near surface of the sample;
4 photoacoustically detecting acoustic waves at a second point spaced from
5 the excitation first point for intercepting shear waves reflected from the far surface of the
6 sample at approximately the angle of maximum shear wave propagation; and
7 detecting the energy level of the intercepted reflected shear wave
8 representations of a flaw in the sample.
- 1 13. The method of claim 12 in which the excitation and detection occurs on
2 the same side of the sample.
- 1 14. The method of claim 12 in which the excitation and detection points are
2 moved along the sample.
- 1 15. The method of claim 12 further including sensing the energy level of the
2 reflected shear wave and recognizing the presence of a potential flaw if the energy level is
3 below a predetermined level.

